this part of the spine, the spinal canal is enlarged laterally at the centres of motion. The paper is illustrated by drawings of the parts described.

March 19, 1846.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"Investigation of the Power consumed in overcoming the Inertia of Railway Trains, and of the Resistance of the Air to the motion of Railway Trains at high velocities." By P. W. Barlow, Esq., F.R.S., M.I.C.E.

The object of the author in this inquiry is to obtain a more correct knowledge than has hitherto been possessed of the resistances which the air opposes to the motion of locomotive engines at great velocities, and of the loss of force arising from increased back pressure and the imperfect action of the steam. For this purpose he institutes a comparison between the velocities actually acquired by railway trains with those which the theory of accelerated motion would have assigned; and his experiments are made not only on trains propelled by a locomotive engine, but also on those moving on the atmospheric railway, which latter affords valuable results, inasmuch as the tractive force is not subject to the losses at high velocities necessarily incident to locomotive engines. A table is given of the theoretical velocities resulting from calculation founded on the dynamical law of constant accelerating forces, in the case of trains of various weights, impelled by different tractive forces, moving from a state of rest; and is followed by another table of the observed velocities in Mr. Stephenson's experiment on the Dalkey line; the result of the comparison being that in a distance of one mile and a quarter, the loss of velocity is about one-half of the observed velocity.

A series of experiments on locomotive lines is next related; but the comparison is less satisfactory than in the former case, because the tractive force cannot be so accurately estimated; it is however sufficiently so to establish the fact, that the power lost by the locomotive engine below the speed of thirty miles per hour is so small as to be scarcely appreciable, and that the time and power which are absorbed in putting a railway train in motion is almost entirely required to overcome the inertia of the train, and does not arise from any loss or imperfection of the engine. It appears, from these experiments, that above one-fifth of the whole power exerted is consumed in putting the train in motion at the observed velocity. The author then enters into some general remarks on the effects arising from this source of loss of power, and the practical application of the knowledge thus obtained. In the atmospheric railway, he finds that the tractive force of a fifteen-inch pipe is so small (being less than half that of a locomotive engine), that the time of overcoming the inertia must limit the amount of traffic which can be carried on

a single line, especially with numerous stations. When a great velocity is obtained, the tractive force of the locomotive is much reduced, and therefore a much greater velocity can be attained on an atmospheric railway.

The inquiries of the author into the amount of resistance exerted by the air on railway trains lead him to the conclusion that in the atmospheric railway the loss of tractive power of the piston from friction, &c. is very inconsiderable; and that the resistance of the air is less than had been hitherto estimated, not exceeding, on an average, ten pounds per ton on the average weight of trains.

A tabular statement is then given of the results of the experiments made by the British Association, for the purpose of comparing them with those obtained by the author from his own observations, and more particularly from his experiments on the Croydon Atmospheric Railway. The general conclusion which he draws from this investigation is that the resistance of the air in a quiescent state is less than had been previously estimated, and that the ordinary atmospheric resistance in railway progression arises from the air being generally itself in motion, and as the direction of the current is almost always oblique, from its producing increased friction in the carriages themselves. This kind of resistance will not increase as the square of the velocity; and as it is the principal one, it follows that the resistance to railway trains increases in a ratio not much higher than the velocity, and that the practical limit to the speed of railway travelling is a question, not of force, but of safety.

March 26, 1846.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

George Newport, Esq. was elected a Fellow of the Society.

"On the Muscularity of the Iris." By Professor Maunoir, of Geneva. Communicated by P. M. Roget, M.D., Sec. R.S.

The author has satisfied himself, from the result of his own dissections, as well as from the concurrent testimony of a great number of anatomists, that the iris is provided with two sets of muscular fibres, the one orbicular, immediately surrounding the pupillary margin and acting as a sphincter; the other, extending in a radiated direction from the exterior circumference of the former to their insertions into the ciliary ligament, their action being to enlarge the pupil. One-fourth of the disc of the iris is occupied by the orbicular, and the remaining three-fourths by the radiated muscle. The author has examined the structure of the iris in a great number of animals, and states the results obtained by M. Lebert, whom he applied to on this occasion, from numerous dissections of the eyes of animals belonging to each class of vertebrata. He also refers to a work which he published in the year 1812, entitled "Mémoire sur